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HAWAII AGRICULTURAL EXPERIMENT STATION
HONOLULU, HAWAII

BULLETIN No. 48

Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE

SWINE RAISING IN HAWAII

BY

F. G. KRAUSS,
Superintendent of Extension Work

Issued May 31, 1923

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HAWAII AGRICULTURAL EXPERIMENT STATION, HONOLULU.

[Under the supervision of the States Relations Service, United States Department of Agriculture.]

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SWINE RAISING IN HAWAII.

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INTRODUCTION.

Probably no other industry in Hawaii is so deserving of thoughtful consideration or has assumed such large proportions in the last decade as the swine industry. Large quantities of fresh pork have always been consumed by the Chinese population of the Territory, but only a very small quantity was produced at home until the early part of 1910. The importations of that year numbered 411 head of swine, which was 1,249 less than had been imported the year previous. That swine do not necessarily have to be imported, but can be produced equally as well in Hawaii as elsewhere, is borne out by a comparison of the imports for the 10-year period ending 1909, when 19,183 head, valued at $154,948, were brought in, with the imports of 1910–1920, when only 597 head, valued at $21,260, were introduced into the islands. Only 86 head, valued at $2,089, were imported between 1911 and 1913, and no importations, except a small number of breeding animals, were made from 1914 to 1919, due to the World War. The following table, taken from the Census Report for 1920, gives statistics of interest concerning the number and value of swine in Hawaii in 1910 and also in 1920:

Number and value of swine in Hawaii in 1910 and in 1920.

Year.	Farms reporting animals.				Animals not on farms.[1]		Total number of animals.	Total value of animals.
	Number of farms.	Proportion of farmers.	Number of animals.	Value of animals.	Number.	Value.		
		Per cent.						
1910	1,396	32.3	20,489	$136,116	10,360	$75,053	30,849	$211,169
1920	1,567	29.7	24,248	397,463	14,692	293,840	38,940	691,303

[1] Laborers and others not operating farms independently often keep animals in the cities, towns, and on plantations. Fully half the swine not reported on farms are maintained as a side line by householders, or by oriental small farmers living outside the city limits.

The period of 1900–1909 was characterized by low prices obtaining on the mainland and by low transportation charges, conditions which served to induce the local importer to introduce swine and also to make competition impossible for the local producer. During this period a few venturesome ranchers improved their herds by the introduction of good breeding stock and new feeds, and there gradually grew up a fair-sized local swine industry. (Fig. 1.) The striking change which resulted in the rapid development and stabilization of the industry, however, was doubtless brought about (1) by the stimulus given local production when importers, sustaining heavy losses from hog cholera on board ship, became discouraged and ceased to introduce swine; and (2) by the advance in the mainland prices and transportation charges to such an extent that local swine raisers found it profitable to compete with the imported product.

FIG. 1.—Old type of Hawaiian pig at right; first cross with good sire at left.

In recent years, heavy importations have been made of the choicest obtainable registered breeding stock of swine to grade up the island pigs. (Fig. 2.) The standard breeds represented include Berkshires, Duroc-Jerseys, Hampshires, Tamworths, Poland-Chinas, and Chester Whites, the first four of which predominate. Comparatively few Poland-Chinas or white breeds have been imported within recent years, although many of the mixed breeds show unmistakable Poland-China blood lines, and occasional hogs are found showing Chester White characteristics, especially the white color.

THE HOG'S CLAIM FOR FAVOR IN HAWAII.

Swine multiply more rapidly, mature more quickly, and make greater gains on a given quantity of feed than do any other class of farm animals, with the possible exception of fowls. They consume not only all the by-products from the field, but from the kitchen as well. Probably no other class of animals can be so profitably handled

on a small scale in Hawaii, or is so especially adapted to the farmer having small capital.

Although local ranchmen and large farmers can not raise swine on ranges as profitably as they can cattle, they are, nevertheless, endeavoring to develop the swine industry on a large scale, and are following, though in a modified way, the system pursued by the Corn Belt farmers of the Middle West. This system is well exemplified on the Parker ranch, where corn is cheaply and extensively grown as a hog feed and it is more profitable to transport the hogs than the corn.

Experiments conducted at the Haiku substation on Maui showed that a variety of crops, including cassava, sweet potatoes, peanuts, velvet beans, cowpeas, and soy beans may be profitably hogged off, and that in the manufacture of starch from cassava the residue, either raw or cooked, can be made to form a large proportion of nutritious feed for swine. Cull beans and seeds of various kinds,

FIG. 2.—A good type of herd boar (Berkshire, Successor's Longfellow 180594).

sugar cane and molasses, and the like, as well as slaughterhouse refuse when well cooked, were also found to form valuable by-products which can be utilized to better advantage with swine than with any other class of animals. When fed to swine, this otherwise waste product is converted into the highest-priced meat, pork bringing in the open market almost double the price of beef and mutton and closely approximating that of poultry.

It is interesting to note that although land values are high on Oahu and comparatively little feed is grown there, fully half the total number of swine produced in the Territory is raised in and around Honolulu. Not only does Honolulu consume more pork than all the rest of the Territory, but the military posts and hotels thereabout daily furnish 20 tons of nutritious feed in the form of garbage, which is sufficient to maintain and fatten approximately 4,000 swine throughout the year. Such a herd is equivalent to

600,000 pounds of fresh pork that can be marketed wholesale at about $200,000. It is understood, of course, that all garbage intended for feeding to hogs should consist only of refuse animal and vegetable matter which has been left over from the table, being free from all such injurious foreign articles as soap, sawdust, coffee grounds, broken glass, and oyster shells, and kept in rust-resisting metal cans that are water-tight and fly proof.

ESTABLISHING THE SWINE PLANT.

THE PERSON IN CHARGE.

As is true of any other industry, the financial success of swine raising depends upon the person in charge. Unless he is deeply interested in his work, knows something of the animal and how to care for it, he is likely to waste a great deal of money and energy in unproductive experiments and ultimately fail in the venture.

The swine raiser who either has land which he is ready to devote to the industry, or who has yet to select a location, should decide whether he will carry on the business as an independent and highly specialized project on a large or small scale, or whether he will make it secondary to other lines of farming, and formulate his plans accordingly. In the latter case, swine raising can be carried on (1) in connection with a dairy farm as a means of profitably disposing of skim milk, as is exemplified on a small scale by several dairy farms producing butter in the outlying districts of the Territory; (2) in connection with a highly diversified farm, such as the writer's at Haiku, Maui, in which the otherwise unsalable residues from truck and seed crops, starch manufacture, dairy, and other sources are converted into marketable products by feeding them to swine; and (3) as in the case of the Kemoo farm, where swine raising constitutes the main and a highly specialized line of farming, with dairying and poultry raising ranking next in importance.

LOCATION.

The location is of paramount importance and should be carefully selected. A business like that conducted at the Kemoo farm, where the main feed is garbage, should be located near a large city, even though land values are high. An enterprise such as that of the writer at Haiku might be profitably established on any of the islands, provided transportation facilities to the other islands are reasonably convenient. Transportation is a primary factor when the enterprise is concerned principally with the production of high-class breeding stock that is to be marketed throughout the islands rather than at some single point. Distance from market is a secondary factor when animals are raised on an extensive scale on cheaply grown field crops and good native pastures.

CLIMATE, SOIL, AND CONFORMATION OF LAND.

Climatic conditions, lay of the land, and type of soil are also matters of much importance. Excessively rainy districts having poor drainage, as well as districts which are either exposed to high winds that prevail during the greater part of the year, or have such

a high altitude that the cold becomes a factor, should be avoided. Swine may be successfully raised, however, when one extreme condition is modified by another that is somewhat favorable, as for instance at Glenwood, on Hawaii, where there is an average annual rainfall of 194 inches, but fairly good drainage and calm atmospheric conditions. The Haiku district on Maui is both wet and windy, but with tree shelters and correct housing conditions is entirely satisfactory for the profitable raising of swine. Swine also thrive at an altitude of from 3,000 to 5,000 feet, where the nights are cold and the seasons are characterized by low rainfall, such as in the Kula, Maui, and Waikee districts of Hawaii.

The swine raiser is advised not to select locations (1) that are cold, low, and wet; (2) that are exposed and windy; or (3) where the seasons are alternately wet and dry and the clay soils are sticky. Ideal locations are those where the temperature and rainfall are comfortable for man, where shelter can be provided against strong winds, and where the soil is not only well drained but fertile for crops as well. Stony land, such as that where the fruit-bearing cactus (*Opuntia* sp.) abounds, is not desirable except for pasture purposes. Sandy soil, or even pure sand, such as skirts the salt-water beaches, when shaded by algaroba or other trees, is apparently ideal for swine raising. So long as they are given intelligent care, swine will thrive under widely varying conditions of altitude and of soil; that is, from sea level to 5,000 feet elevation, on pure sand to heavy loam, stony land, and on Manienie (Bermuda) sod.

HOUSES, INCLOSURES, AND FENCES.

The convenience and economy of operation, as well as the health and comfort of the hogs, depends to a large extent upon the general plan of the inclosures and houses. The housing problem is fortunately a simple one in the mild climate of Hawaii.

Hogs can be raised to advantage in an inexpensive house provided it is well planned and placed, well lighted and ventilated, and can easily be kept clean. Small pens should not be built on rocky ground because they are hard to keep clean and soon become insanitary. When confined in such pens heavy hogs often become lame. The construction should not be of concrete unless the method of stall feeding with garbage is practiced on rather an extensive scale. Concrete structures are not only unnecessarily expensive, but they are cold in wet weather, and the floors, unless they are overlain by plank, are hard on the hogs' feet and pasterns. On the other hand, a well-laid concrete floor is sanitary and can easily be kept clean. (Figs. 3 and 4.) Large central or community houses of all kinds should amply provide for the admittance of direct sunlight during the greater part of the day, and an abundance of fresh air at all times. Small houses or individual cots are best made on the open front plan, admitting both light and air.

In the central housing system the pens (farrowing pens and the like) for individual animals are usually 8 by 8 feet to 12 by 12 feet square, or of dimensions giving an equivalent area. In the individual house or colony system, especially when the cots are of the portable type, there may be less space. (Figs. 5 and 6.) A good dimension is 7 by 7 feet, although the writer's "New Era" type of

FIG. 3.—Cement pens and iron fenced runs. University of Hawaii farm.

portable cot is 6 by 7 feet, and 1 foot of the longer dimension is occupied by a self-feeder. (Fig. 7.) These cots have served their purpose well for hogs weighing up to 500 pounds. Every farrowing pen should be provided with fenders, set along the sides about 10 inches above the bed, to prevent the dams from lying against the partition or upon their young. The pigs will creep under the fender when the mother lies down.

Outdoor pens should be of such size as to permit of the hogs getting plenty of exercise. If it is to be attached to a large central house, the outside run will necessarily have to be of the same width as that of the inside pen unless the interior is so arranged that the animals can be let out on either side. If the alternating pens have

FIG. 4.—Brood sow and pigs in one of the pens shown in Figure 3. Pens are mostly sanitary and strong, but hard on the animals' feet.

FIG. 5.—Movable individual hog house or cot.

outlets on opposite sides, the yards may occupy the width of two inside pens. Every yard should be provided with some shade trees, preferably Pride of India trees. (Fig 8.) Hogs do not injure such trees, while they quickly destroy eucalyptus, algaroba, and kukui, and other otherwise desirable trees. The placing of palm leaves, or even of old burlap bags, over a light frame of poles furnishes a good temporary shelter from the rays of the sun. A clump of widely

FIG 6.—Type of colony hog houses extensively used on Maui.

spreading trees affords the greatest comfort to hogs that are confined in large inclosures and pastures with either fixed or portable houses.

The ground occupied by the swine should slope away from the house so as to facilitate drainage. Hog houses should never be built at the base of a slope.

Hog fences are a serious problem to the average swine raiser. Hogs get through fences with greater ease perhaps than does any other class of animals. A fence should be about 4 feet high and strongly constructed with, preferably, split redwood posts. The posts should be set 3 feet deep and 8 feet apart and have firmly spiked to them 1½ by 12 inches by 16 feet planks, which are set

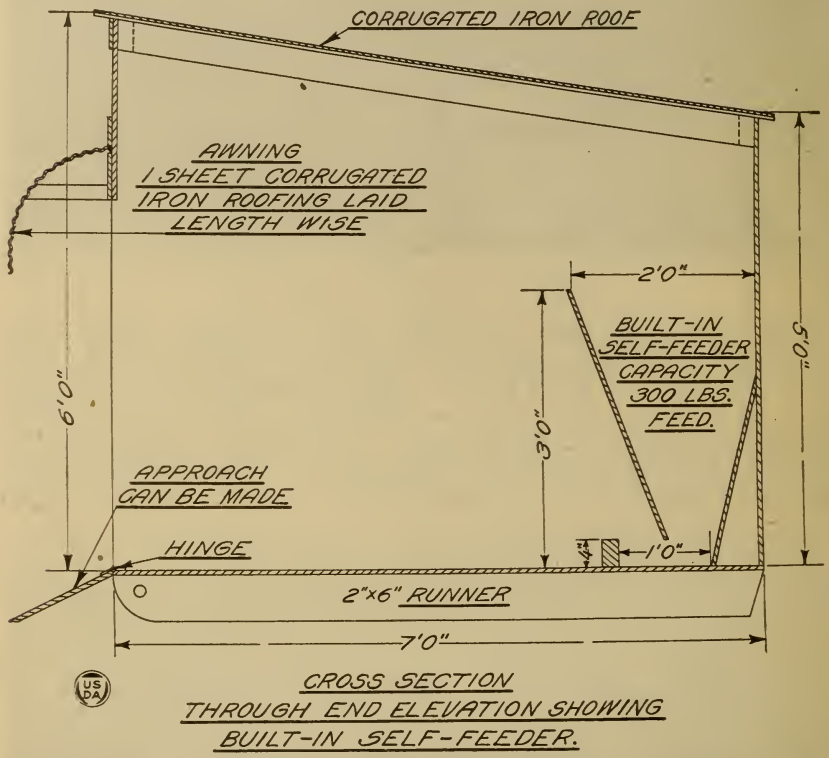

FIG. 7.—New Era Homestead farm, Haiku substation. Portable colony house or hog cot with built-in self-feeder.

6 inches in the ground along the fence line. A plank, 1½ by 12 inches, should also be set above the baseboard, and the joints should be broken to give rigidity to the fence. The heaviest and closest woven wire hog-fencing obtainable, 32 to 36 inches high, should be stretched tightly across and securely stapled to the plank and posts. The fence can be greatly strengthened if the lower part of the wire fencing is placed between the plank and posts rather than on the outside of the plank. The wire fencing should be lapped at least 3 inches down the back of the plank and surmounted with a strand or two of barbed wire. (Fig. 9.)

Boar fences should be higher than 4 feet and very strong. A pedigreed Tamworth boar weighing 600 pounds has been known to

jump a 5-foot fence. Swine are usually more contented in large or temporary inclosures than in small yards, and when thus confined need not be fenced so thoroughly.

At the Haiku substation a heavy woven wire hog fence, 36 inches high on level ground without base or top boards has given entire satisfaction for inclosing temporary hog pastures. Such fencing must be very tightly stretched at the anchor posts, which are firmly set from 12 feet to a rod apart. It may be of advantage to plow a straight furrow along the proposed fence line to permit of setting the wire netting several inches in the ground. The height of the fence above ground is lowered when this is done and the fencing should be topped with a strand or two of barbed wire. To be effective, the wire should be double barbed and the barbs should be close spaced.

FIG. 8.—Pride of India tree. A satisfactory shade tree for hog paddocks. Not injured by hogs.

Hog gates can not be too strongly built. Those in use at the Haiku substation have withstood heavy strain for five years. Made of rough Douglas fir boards of 1 by 6 inch stuff, these gates are of two sizes, 4 and 8 feet wide by 4 feet high. Five pieces, spaced 4 inches apart, constitute the horizontal plane giving a height of 48 inches, allowing a clearance at the bottom of 2 inches. The horizontal pieces are fastened together at the ends by a piece, 1 by 6 inches, on either side, with diagonal pieces additional to give rigidity. Each lap of the frame is fastened with one or two three-eighths inch carriage bolts in addition to nails, and heavy hook hinges are used in preference to strap hinges. The hook of the top hinge is placed in an inverted position so as to make it impossible for the hogs to lift the gate off its hinges. The best and cheapest latch in use at the Haiku substation is a 1 by 4 inch strip, 3 feet long, dressed to fit snugly in the space lying between the second and third from the top horizontal gate boards. A round peg, $1\frac{1}{4}$ inches in diameter, is placed in this latch at the center for convenience in opening the gate, and a hole, 1 by 4 inches, passes through the fence post to receive the latch when the gate is closed.

OTHER EQUIPMENT.

Nearly all modern swine plants are equipped with dipping vats, rubbing posts, hog wallows, self-feeders and pig creeps, feeding racks, breeding and loading crates, and the like.

The dipping vat.—The dipping vat is not recommended for use unless large numbers of hogs are to be maintained and are especially subject to vermin.

FIG. 9.—Hog fence of woven wire with strand of barbed wire at top. Portable hog cot in background.

FIG. 10.—Tamped earth wallow in pasture.

Rubbing posts.—An effective and cheap method of controlling hog vermin is that of placing burlap or other heavy cloth sacking, satu-

rated with crude oil, on posts at a height which will permit of the animals rubbing against them. The sacks should be frequently saturated with the oil.

Hog wallows.—A good hog wallow should be accessible to the swine.

FIG. 11.—Concrete wallow. Crude oil on water surface to destroy vermin.

It not only affords a cool, refreshing bath in hot weather but it also is very effective in freeing the animals from flies and scurf. Wallows of concrete construction are more sanitary than mud wallows. The addition of sufficient crude oil to form a thin film over the surface of the water tends to keep the animals free from skin parasites. (Figs. 10 and 11.)

Self-feeders and pig creeps.—No hog farm is complete without the self-feeder. (Figs. 12 and 13.) This device enables the hogs to satisfy their craving for feed at any time, and is perhaps the most economical method of fattening the animals, because, while a slightly increased amount of grain may be consumed, it requires the least labor. The self-feeder should be made of well tongued and grooved boards having a planed surface. The smoother and straighter the sides the more readily will the feed flow. The feeder should be provided with a good rain-proof cover to prevent the feed from getting wet and spoiling when in use out of doors, and the size of the open-

FIG. 12.—Large self-feeder for whole algaroba beans.

ing should be regulated and the feeder set on a large platform to prevent waste of feed.

The V-shaped trough, which is an effective and cheap method of feeding garbage, should be made of boards of good quality, 1½ or 2 inches thick. (Fig. 14.) In permanent central hog houses having concrete flooring and concrete or wooden feeding troughs, provision should be made for drainage. (Fig. 15.) The bottoms and corners of concrete troughs should be rounded and the dimensions should be 1 foot wide and 8 inches deep. Such troughs may be used for water as well as for feed.

FIG. 13.—Small, three compartment self-feeder.

A pig creep can be formed by placing a small self-feeder in the corner of the yard and partly boarding off that corner to keep out the sow. Sufficient space should be left under the boards to enable the young pigs to creep in and feed without disturbance, or small openings may be left at each end for this purpose.

Feeding racks.—Racks for the feeding of all kinds of green forage are valuable means of reducing waste. The sides should be made either of 1 by 4 inch wood slats, spaced 4 feet apart, or of heavy woven wire hog fencing having approximately 4 by 6 inch meshes.

Watering devices.—Special attention should be given to watering devices for swine. Where it is not practical to utilize the feed troughs for the double purpose of watering and feeding, a patented so-called hog drinking fountain can be used. This device consists of a cast-iron bowl having three connected compartments from which three animals can drink at the same time. The drinking bowl has a protected center containing a float valve that automatically keeps it filled with water. Since the water is drawn under pressure from a pipe line the bowl may be placed anywhere that water can be piped. It occupies less than 4 feet square of floor space, will accommodate from 50 to 100 full-grown hogs, and is accessible to the smallest pig. This device is very economical of water. The drinking fountain should be bolted to a concrete or plank platform to prevent its being displaced by rooting hogs. Such a drinking fountain can be had for about $20 and will likely be very durable.

FIG. 14.—V-shaped concrete feeding troughs. Sanitary and durable.

In individual pens where room is limited, cast-iron water bowls, such as are used for cattle, have proved very satisfactory. These bowls are connected with a pressure water system, the water being admitted through a valve having a winged lever that is paddle shaped. When the hog presses upon the lever the water runs into the bowl, and when the pressure is removed the water is automatically shut off by means of a spring.

Breeding and loading crates.—A breeding crate is a necessary adjunct to every breeding establishment. By means of it the heaviest boar can be utilized expeditiously without injuring the smallest sow. Some sows, although in heat, will not take the boar readily, and the

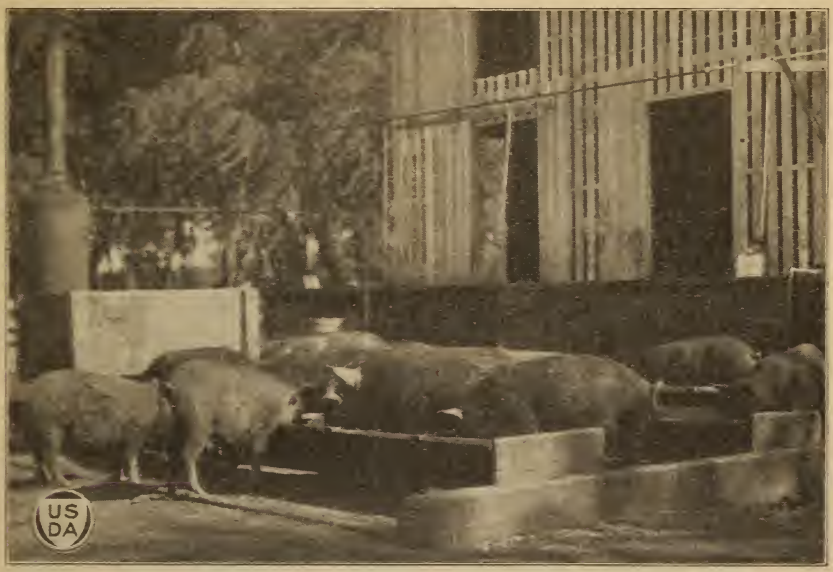

FIG. 15.—Molokai ranch piggery. Concrete floor and wooden troughs. Steam boiler and vat for cooking feed in background.

use of a crate in such instances insures a successful service. Many breeders use a crate for all of their sows.

Any carpenter can make a breeding crate. The materials needed include a stout frame, which is made of 2 by 4 inch scantlings, closed in front and open in back, a bar to slip behind the sow just above the hocks, and a 2 by 4 inch strip which is attached to both sides of the forward end of the crate at about the height of the sow's head, and extends to the rear of the crate where it is fastened to the bottom. The boar's forefeet rest on these strips.[1]

Breeders who ship choice hogs long distances should standardize their shipping crates to insure comfort for the animals and at the same time to serve as advertisements for themselves. The crate should be strongly and neatly constructed and neither excessively large nor small. (Fig. 16.) The floor of those intended for shipment should be made of solid 1-inch boards. The sides, ends, and top of new 1 by 4 inch lumber should be spaced according to the size of the hogs to be shipped.

[1] For details, see U. S. Dept. Agr., Farmers' Bulletin 966, A Simple Hog-breeding Crate.

A chute is of great convenience in loading hogs into trucks. It should be as wide as the wagon or truck bed, 10 feet or more long, and have sides 3 feet high. If it is mounted on a pair of wheels it can be moved and tilted with ease.

THE FOUNDATION STOCK.

Having determined what system of management he is to follow and where he is to be located, the swine raiser should next turn his attention to the establishment of the herd itself, taking great care to select, or have selected by a reliable breeder,[2] animals of good type, conformation, and constitution. (Fig. 17.) Too much stress can not be placed upon the judicious selection of a pure-bred herd which is to be used for the production of breeding stock for sale as such.

FIG. 16.—Type of crate used in shipping hogs.

A few choice animals, rather than a number of inferior ones, should be purchased at the start. It is advisable never to buy the highest priced swine until one has had considerable experience in breeding. In some instances it is wise to purchase bred sows and a young boar whose services will become available at the next breeding period. If the sows are in pig, both sow and litter can be studied by the purchaser and later bred to a suitable sire which is chosen to head the herd.

In general, it is recommended that the beginner purchase young stock. The investment is low, and the animals usually adapt themselves better to new conditions than do older stock. A boar pig of the best breeding possible and two or four sow pigs from 4 to 6 months old will be sufficient as a start, or if grade sows are already on hand, or the start is to be made with mature animals, the purchase

[2] Pure-bred stock should be purchased from reliable breeders only, preferably from those specializing on a single breed.

should be confined to one good, vigorous boar of any breed that best suits the breeder.

The standard breeds[3] may be roughly classed as the heavy or lard types, under which are usually placed the Poland-China, Duroc Jersey, Berkshire, Chester White, Hampshire, Mule Foots, Essex, Victoria, and Cheshire; and the bacon type, as characterized by the Tamworth and by the large Yorkshire and Suffolk. Apparently no one breed is better than another for the show ring or for the market.

The matter of breed is of less importance than is that of strain, except when it is desired to sell pure-bred stock of a definite breed. Some consideration should be given to the market demands, but inasmuch as these are not as yet exacting in Hawaii the beginner is privileged to select the breed that he fancies most. Each of the standard breeds as developed by the leading breeders has its special

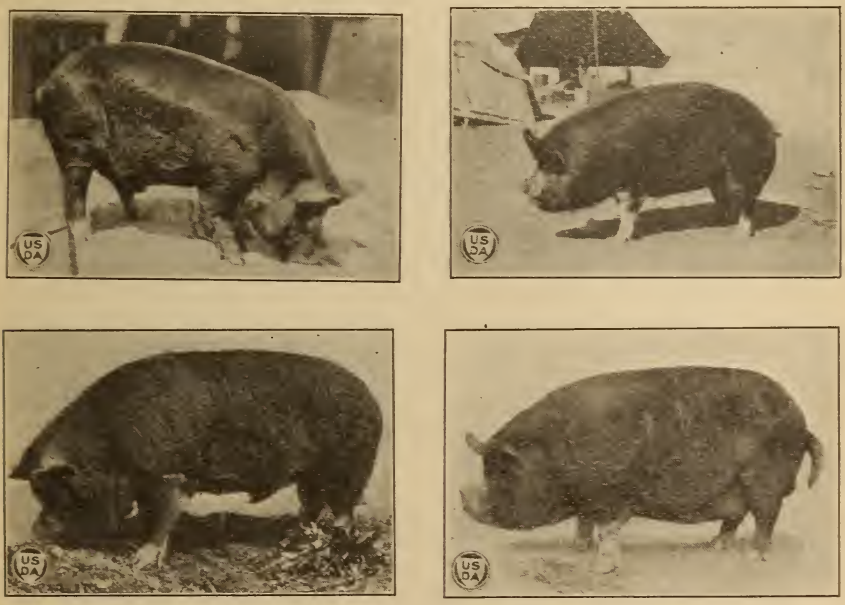

FIG. 17.—Some types of Berkshire hogs owned in Hawaii.

merits, but the man who breeds for the market usually pays more attention to type than he does to breed.

Stock as uniform as possible should be selected when a number of sows are purchased for the foundation herd. Such animals can come only from a uniform herd, uniformity being the best criterion of the worth of the stock. They will not only feed and develop better than swine lacking in uniformity but also command better prices, whether they are sold as pure stock or on the market.

Good sows are all important in obtaining satisfactory results. They may be promiscuously selected from pure breds and grades, but all should conform to a certain type, be similar in color, marking,

[3] No description of the breeds is attempted in this bulletin because every standard work on swine describes them in more or less detail.

and conformation, and producers of good litters which they are capable of properly mothering. The brood sow should show femininity, as is characterized by quality and refinement in all parts of the body. The body should be rather long, the ribs well sprung, and the sides long and deep. The shoulders should be smoothly covered and the hams well rounded and plump. The legs should be well placed and the pasterns strong and straight. Roomy sows are regarded by many judges of swine as being especially high in fecundity.

No effort should be spared to select the best boar that can be afforded. To be of the greatest usefulness, he must be prepotent in transmitting his best qualities. He represents half of the breeding stock and is rated the most important animal in the herd because he exerts a strong influence upon every pig that he sires. A superior boar will improve the progeny of inferior sows, but an inferior boar will depreciate the offspring of sows of high quality. The boar should not only have every appearance of quality but also be of as high breeding as possible. The show ring tells only half the story; the record of performance in the herd tells the other half, which is the more important factor of the two.

The essential qualities in the boar are that he be strongly masculine and, if mature, have well-developed shoulders and hindquarters, a slightly arched and deeply fleshed back, and sides of good length and depth. He should stand up well on his hoofs and show no weakness in the pasterns. The testicles should be prominent and uniform.

The successful hog raiser, whether he is a breeder of market hogs or of pure-bred stock for sale as such, is always a close observer, and soon learns the strong and weak points of his herd boars and sows and what their prepotency is in transmitting these qualities. Brood sows that are shy breeders, poor in nursing their young, difficult to manage, or inclined to be savage, and boars that are unable to transmit their good qualities should be discarded before their influence has made much headway.

The beginner in swine raising, especially of pure-bred stock, may as well learn at the start that he will have to do some culling if he would attain high standing. No breeder ever made a greater mistake than that of expecting a large percentage of the progenies of, say, a trio of prize winners to become prize winners in turn. This does happen sometimes, but only under the care of the master breeder.

Prospective buyers are advised to attend the swine exhibits at agricultural fairs and to follow these observations with visits to the show herd in their homes. Grade sows for the production of market pigs usually can be bought at costs slightly above butcher market prices. When large numbers of sows are to be purchased, the buyer, if he is a judge of hogs, should watch shipments at points of embarkation or destination, and also search for desirable animals among the herds of the numerous small swine raisers who are scattered throughout the Territory. It often happens that some of the best looking sows, when purchased on the market, are nonbreeders. This is more or less likely to be the case unless the animals are guaranteed to be breeders. No pure-bred swine, either male or female, should be bought without such a guaranty.

GENERAL MANAGEMENT OF THE HERD.

It is of course assumed that an ample supply of green crops and grain or by-products is on hand before the swine arrive. Beginners frequently make the mistake of poorly balancing their stock and feed and consequently of having to purchase additional feed, often at high cost, after the stock arrives.

Regardless of how good it is, the herd is made or marred by management. The breeder may be an excellent judge of swine and able to mate them for the best results in breeding, but if his system of every-day care, which is known as management, is irrational, the animals will not thrive and the most rigorous selection will be rendered ineffective. Much feed and effort are wasted, even when the herd is carefully fed and managed, when the individuals are either poorly selected or poorly mated. A thorough knowledge of the work to be done, together with hard work and untiring efforts, is the price of successful swine raising. It is wise to build up pure-bred stock slowly, especially in the beginning.

Neither boar nor sows should be bred under 9 months of age, and then only moderately. A year-old boar will take care of 10 sows nicely, and when fully mature can be placed at the head of 20 or 30 sows. Two herd boars should be maintained, if possible, and their breeding propensities tested on each sow in turn.

Before breeding is begun the herd should be carefully distributed and comfortably settled. The boar should be placed in a pen by himself, and the dry sows of equal age or size, if of good disposition and from the same herd, grouped in pasture. New animals should be quarantined for at least 30 days and freed from vermin before they are placed with the established herd.

Brood sows should be turned into a separate pasture, kept quiet, and well cared for. A week or two before farrowing time, which occurs about 112 days after breeding, each sow should be placed by herself in a yard where there is a crop and a small pen so that she will become accustomed to the new surroundings before farrowing. The sow should be made as comfortable as possible as farrowing time approaches. She should be kept in good condition, but not allowed to get too fat.

Feeds that are laxative, but not too rich, should be given toward the close of gestation. The bedding should consist of clean, dry beach sand or short litter. Long straw or weeds are likely to cause entanglement of the young. Sows should not be allowed to farrow on a bare cement floor, because both mother and young will take cold.

Some one should be in attendance at farrowing time to lend assistance if needed. The young should be removed to a clean, dry, warm box, and returned to the mother every two or three hours. When the pigs are from 12 to 18 hours old they can generally be left with the sow with perfect safety. Mortality can be greatly reduced among the pigs if they are tenderly cared for during the first week of life.

For the first 24 hours after farrowing the sow should receive no feed whatever, but she should be given a liberal supply of lukewarm

water at frequent intervals. After the first 24 hours she can be fed a light slop of middlings, the amount being gradually increased and the pigs closely watched that no white scours appear. When the pigs are 10 days to 2 weeks old the sow should be on full feed, and after that time until weaning she should receive all the feed she will consume. Once the sow loses in flesh she can not do justice to her litter and it will be difficult to bring her back to breeding condition.

Pigs should not be weaned until they are 10 weeks of age unless some special occasion requires earlier weaning. A properly fed sow is in a good flow of milk when the pigs are 8 weeks of age and her milk is by far the best feed possible for them. When the pigs are 2 or 3 weeks old they develop an appetite for some feed to supplement the sow's milk and should then be given skim milk or buttermilk mixed with a little wheat middlings and other meal to relieve the mother. When they are about 6 weeks old they should be provided with a "pig creep," where they may receive a special feed mixture including tender alfalfa, and the like.

The feed of the sow should be reduced 2 or 3 days before weaning time, and the mother taken from the pigs, which should then be given access to the self-feeder in the creep. At the Haiku substation, after the young are weaned the sows are turned into a good pasture of succulent green feed, preferably a leguminous crop such as alfalfa, cowpeas, or velvet beans.

The weaned pigs may be left together until they are 10 or 12 weeks old. They should then be sorted according to size and turned into pastures or pens not exceeding 20 or 30 head. Male pigs, which are not wanted as breeders or intended for early market, should be castrated a sufficient time before weaning to permit of their being thoroughly healed at that time; otherwise, they should be separated from the females before reaching the age of 4 months.

The younger the pigs are the more economical will be their gains. Up to weaning age 3½ pounds or less feed will produce a pound of gain. From weaning time (10 weeks of age) to 4 months, 4 pounds of feed will make 1 pound of gain. The animal should weigh about 100 pounds at the end of the 4-month period. Gains at the rate of 2 pounds per day are not uncommon when all conditions are favorable. At 6 months of age a pig should weigh from 150 to 200 pounds. Gains over 150 pounds are attained at a cost of 4½ and 5 pounds of grain per pound of gain. A well-bred and well-cared-for pig pasturing on good leguminous crops should gain an average of 1½ or 2 pounds daily on less than 5 pounds of grain feed per pound of gain. In the two Maui County Boys and Girls' Pig Club contests high-grade Berkshire pigs having an average weight of 40 pounds at the beginning of the contests gained over 200 pounds in 100 days.

Pigs intended for market stock should be brought up to 150 pounds weight on pasture supplemented with a fairly liberal ration. They should then be fed from 25 to 30 days on grain and carbohydrate material, among the best of which is corn, supplemented with a little tankage or blood meal. Fed thus, they should gain 2 pounds a day and command the highest market prices. Pigs gaining 1 pound or less a day under good feed and care are not profitable in Hawaii

under the present price of feeds. The swine raiser should weigh all his pigs at definite intervals and also keep close check on the kinds and amounts of feed being used. This is the only way that he can know with any degree of certainty how things are going.

The following weights are considered very satisfactory at the ages specified:

Satisfactory weights of pigs of varying age.[1]

Age.	Weight.	Age.	Weight.
Days.	*Pounds.*	*Days.*	*Pounds.*
50	30 to 50	270	275 to 300
100	75 to 100	365	325 to 400
180	150 to 200		

[1] Average weights under best conditions. The heaviest weights at the Haiku substation for two 6-months old barrows was 422 pounds.

PIG-EATING SOWS.

When a sow develops an abnormal appetite and begins to eat her young, she is usually in a fevered condition, probably due to improper feeding during the period of gestation, and needs an oil-meal ration to regulate the bowels. The pig-eating tendency can be warded off by giving the sow a ration containing generous amounts of meat scraps and tankage during gestation. After she has farrowed the sow should be placed in a pen by herself, and the young should be brought to her at regular intervals for nursing and personally guarded until they are returned to their own pen. Should these precautions fail to make the sow properly mother her succeeding litter, she should be disposed of to the butcher.

SOME PRINCIPLES OF SWINE FEEDING IN HAWAII.[4]

Feeding is the most expensive part of swine raising, and it is not unusual for the cost of feeds to equal or even exceed the value of production of the animals. As an example, it requires, on the average, at least 5 pounds of grain or milled feed to produce 1 pound of gain, live weight, in hogs that are not provided with pasturage or green feed, or which are given a poorly balanced ration. When it is selling at $50 a ton (2½ cents a pound), which is the lowest average price paid for grain in Hawaii, feed needed to produce 1 pound of pork, live weight, will cost 12½ cents, which is the minimum. When, however, the maximum cost of feed, $100 a ton or 5 cents a pound, is taken as a basis, 1 pound of pork, live weight, will cost 25 cents. During the past five years the range of prices of live hogs on the Honolulu market has very closely approximated the figures representing the feed cost of production, with the result that the animals could seldom be supplied with commercial feeds at a profit at any period, as is frequently the case on the mainland.

From the foregoing it may readily be surmised that it is hazardous to undertake to raise market hogs entirely or nearly so on purchased grain and milled feeds. Investigations made at a number of the most profitable swine-raising enterprises in Hawaii showed that the quantity of feed purchased by them is relatively small, amount-

[4] See also Hawaii Sta. Press Bul. 53 (1918).

ing to less than 10 per cent of the total consumed. It other words, fully 90 per cent of the feed consumed at the more profitable enterprises is home grown. The striking exception to feeding home-grown products at a profit is in the case of the extensive garbage-feeding enterprises being conducted on Oahu, where practically all of the feed is purchased outright at a comparatively low figure.

Unless the swine raiser is favorably situated where garbage or other by-products suitable for feeding can readily be obtained at a cost lower than is asked for the grain equivalents, farm crops for feeding to market hogs should be produced at a cost that is commensurate with the returns. When highly bred stock is raised for selling for breeding purposes the situation is somewhat changed, but even then the breeder should produce forage crops as extensively as possible for feed.

The swine raiser should endeavor to familiarize himself with the underlying principles of nutrition, as well as of feeds and feeding, if he would feed hogs economically and profitably in these days of intensive production and keen competition. In the first place he should know that the digestive organs of swine with their contents comprise only about 7.5 per cent of the total weight of the body, while those of cattle are more than 14 per cent. In the second place, he should know that horses, cattle, and sheep are normally herbivorous, living as they do on grass and herbage, while the hog is omnivorous and feeds not only on tender herbage, roots, and seeds but also on animal matter. The hog also, in its effort to extract feed from beneath the soil, swallows considerable earthy matter. Having a stomach of rather limited capacity and a peculiar digestive tract, swine require feed that is more concentrated and digestible and less fibrous than is needed for any other class of farm animals.

The changes which food undergoes within the digestive tract prepare it for absorption into the circulatory system, where it is used to build new material, repair body waste, and to act as a source of energy. The true or digestible nutrients are food constituents that aid in supporting animal life, such as crude protein, the carbohydrates, and fat. Air, water, and mineral matter also come under this heading.

A "ration" may be termed the feed allowance per day per animal, whether it be fed at one or several meals. A "balanced ration" is the feed or combination of feeds containing the several nutrients protein, carbohydrate, and fats, in proportion and amount that will furnish one animal with the optimum amount of nutrition in 24 hours.

The relative usefulness of different feeds depends largely upon the digestibility of their several nutrients; that is, upon the percentage of total crude protein, fiber, carbohydrate, and fat that is digested by the animal. After the feed is chemically analyzed, it is given in weighed quantities to the animal, and for a reasonable length of time after feeding the urine and feces of the animal are also weighed and analyzed. The difference between the amount of each nutrient fed and of that eliminated represents the digested portion.[5]

[5] Data showing the determination of the digestible nutrients in a great many feeds are to be found in all standard textbooks on feeds and feeding. Feeding standards that have been worked out experimentally to show the amounts of digestible nutrients which are supposed to be best adapted to different animals for maximum production do not take into account the element of cost. They should, therefore, be used as a guide rather than adhered to blindly.

One of the first essentials of a ration is that it be palatable, so as to induce heavy consumption and stimulate digestion. Secondly, it is important, especially for swine, that the nutrients be sufficiently concentrated to supply adequate nourishment within the bulk capacity of the animals fed. It has become currently accepted in some quarters that either little or no gain can be made by hogs when they are fed forage crops alone. In experiments carried on at the Haiku substation, it was found that the feeding of a combination of forage crops resulted in profitable gains.

Suitability of the feeds entering into the ration is of course very important. Cotton-seed meal is an excellent illustration of what should not be used. It makes a highly concentrated and excellent feed for cattle, sheep, and even for horses, but being sometimes toxic to pigs it is not suited for swine feeding. On the other hand, the soy bean is a good protein feed for growing hogs but should be used with corn or other carbohydrate feeds.

Feeds that have been damaged by mold should never be fed to any class of animals. The feeding of spoiled tankage or dried blood is likely to result in ptomaine poisoning, while condemned salt salmon and brine-preserved feeds may be followed by the death of the animal. Garbage that has been contaminated with dishwater containing soap powder or lye has been responsible for the loss of many hogs.

Animals feeding on succulent pasture should be deprived of further laxative feeds, such as linseed meal. Since a number of the feeding standards do not take into consideration the animals' need for mineral matter and the ordinary ration is deficient in it, it is suggested that lime, phosphoric acid, and iron, together with some salt, be made available to the entire swine herd in addition to the amounts that are naturally supplied in the feed. The vital processes of the animal seem to be dependent upon an adequate amount of these mineral salts.

A variety of feeds is greatly to be preferred to a ration that is made up of one kind only. Mixed feeds are usually better balanced and more palatable, whether as forage, roughage, or grain concentrates, than is a single kind. Variety gives the feeder greater opportunity to meet the needs of the animal, and frequently permits of substitutions at a considerable saving of money. A change in ration is also easily and safely effected when a variety of feeds is available and fed judiciously.

An abundance of clean, cool water should always be accessible to swine. Water is as essential as solid food. As a matter of fact, animals can live longer without the latter than without the former. When water is lacking the processes of mastication, digestion, absorption, and assimilation are hindered. Swine ordinarily consume 5 pounds or more of water to every 1 pound of dry matter. Feeds that are rich in protein create a greater thirst for water than do starchy foods.

The raising of breeding stock should not be considered unless the breeder is prepared to raise liberal and constant supplies of green succulent feed. While they are not absolutely essential to the successful feeding of swine, succulent green feeds, either as soilage or as pasturage, are greatly relished by animals of all ages and form the cheapest part of the ration when they are produced at home. Green feeds not only have a beneficial laxative effect and keep the

digestive tract in good condition, but they also have a nutritive value and doubtless supply in great part the vitamins forming a part of every efficient ration.

The feeding value of the nutritive constituents of the different kinds of feeds may vary considerably. Carefully conducted experiments have shown that the vegetable proteins are greatly inferior to the animal proteins as a hog feed, and that the protein in cotton-seed meal is inferior to that in linseed meal, although both feeds are very rich in the constituent.

Whole wheat and its by-products, bran and middlings, are valuable as hog feeds, but chemical analyses have shown them to differ widely in composition. Roughages are even more variable than the cereals, since their composition is influenced by climate, state of maturity, quality of curing, and by moisture content. Alfalfa, both in the fresh green state and when cured, is among the most variable in feeding value, its composition being influenced by state of maturity and by the methods of curing employed. Prime alfalfa meal may almost equal wheat bran in feeding value, but alfalfa that has lost most of its leafage as a result of being overmature or overcured may become so low in value as to be practically worthless. Cured alfalfa, while averaging about 15 per cent protein, may contain as high as 30 per cent or as low as 10 per cent crude protein, in the latter case of which there is an excessive amount of crude fiber; and conversely, the coefficient of digestibility is likely to be higher in the high protein sample than in the low-grade sample.

Although American authorities do not generally recommend as profitable the grinding and cooking of feeds, the Haiku substation, in experiments conducted for more than five years, found that both grinding and cooking certain feeds are profitable practices, especially when the feeds and feed products are both of high value. In fact, much of the feed used during the experiments could not have been fed to advantage had they not been ground and cooked. Cooking certainly insures the feed against the possibility of transmitting tuberculosis and hog cholera when offal is used and against detrimental fermentation. The practical swine raiser in Hawaii might do well to try out various feeding methods to determine which are suited to his needs and conditions.

DISEASES AND AILMENTS.

The average conditions obtaining in Hawaii foster the spread of swine diseases. Every precaution should therefore be taken to avoid crowding the animals or exposing them to sources of contagion. Whenever the animals are returned from places of exhibit or new animals are received they should be segregated from the main herd for several weeks or until it is certain that they carry no disease. The hog yards should be thoroughly treated with some good disinfectant every three or six months and the entire quarters changed every three to five years to lessen the danger of infection. Other precautionary measures include keeping the pens and runways clean at all time and providing the pens with proper drainage and ventilation as well as with clean drinking places.

A veterinarian should be consulted as soon as disease appears in the herd so that measures can be taken to save the animals that are

not beyond help. The matter should also be reported to the Territorial Veterinarian, Board of Agriculture and Forestry, Honolulu.

ABORTION.

In abortion the sow loses her pigs before they are fully developed. Abortion not infrequently accompanies other diseases, but it also occurs when the sow is in otherwise perfect health. In the latter case abortion may be due to bacterial infection. After the first abortion is noted all pregnant sows should immediately be removed to new ground where hogs and cattle have not recently been kept. They should be divided into as small groups as possible. If it is thought that the abortion germs have been contracted from cows, the milk should be pasteurized before it is fed to the swine. Abortion has never officially been reported as occurring among the swine of Hawaii.

BRONCHITIS.

When affected with bronchitis, the hog presents a general unthrifty appearance and has a persistent cough. Predisposing causes to bronchitis are dust, worms, germs, poor ventilation, and dampness. Insanitary conditions should be remedied and the animal given good feed. The feeding of skim milk to young pigs and shotes will strengthen them sufficiently to overcome the disease.

HOG CHOLERA.

Hog cholera is a very serious disease and probably causes greater loss in the swine industry throughout the States than does any other disease. The presence in Hawaii of true hog cholera has not as yet been indisputably established. The microorganism carrying the infection is so small that it can not be seen even with the most powerful microscope. The disease is characterized by fever, loss of appetite, cough, weakness of the hind parts, general prostration, and a purplish discoloration of the skin. In some instances the animal suffers from constipation and later from diarrhea.

As soon as there are symptoms of cholera a veterinarian should be called to administer treatment. Strict quarantine should be maintained between the sick and healthy hogs, the unaffected animals being transferred to clean, new quarters. Antihog-cholera serum is effective in protecting healthy swine from cholera.

LUMPY JAW.

Lumpy jaw, which in swine most commonly affects the mammary glands, is probably due to the same fungus that causes lumpy jaw in cattle. Large, hard, tumorous masses containing many pus cavities form on the mammary glands when the animal is affected. A veterinarian should be called to remove the masses and prescribe the use of potassium iodid.

PNEUMONIA.

Pneumonia is caused by an organism and develops in pigs which are exposed to inclement weather or dust, or which are forced to live either in filth or insanitary yards, or in close, damp, poorly ventilated hog houses. In pneumonia the breathing is rather labored and

there is weakness, fever, and a cough. The animals should be provided with clean, warm, airy, dry quarters and given a well-balanced ration containing plenty of protein constituents. Annoying the animals by giving them medicine in this disease usually does more harm than the medicine does good.

RHEUMATISM.

Rheumatism is characterized by lameness and swollen joints. The disorder is prevalent where stable and yard conditions are poor and the animals do not get proper exercise. They should be changed to sanitary quarters and fed on sour milk. Fifteen grains of sodium salicylate to every 100 pounds of hog should be administered in the ration once a day.

RICKETS.

Rickets is characterized by large joints and bones, crooked limbs, and a general unthrifty appearance. The disease is directly traceable to lack of bone-forming ingredients in the ration of the pregnant sow and young pigs. Bone meal and phosphate of lime should be added to the ration and sanitary quarters should be provided for the animals. If possible, provision should be made so that the pigs can get plenty of exercise and have facilities for pasturing.

INFECTIOUS DIARRHEA.

Infectious diarrhea occurs largely among young pigs and is accompanied by intestinal ulcerations. Pigs so affected are inclined to develop pneumonia. The disease is caused by an organism of the colon-typhoid group which is introduced into the system with food or drinking water. Foul yards and pens are responsible for its occurrence among swine. When it does occur, all pigs and pregnant sows should be removed to new ground and segregated into small groups. The use of concrete feeding troughs, which permit of thorough cleansing, is very effective in preventing infectious diarrhea.

TUBERCULOSIS.

Tuberculosis in swine is usually contracted from tuberculous cattle. There are no easily diagnosed symptoms of the presence of the disease. In the advanced stage, intestinal tuberculous swine suffer from disturbance of the digestive tract and sometimes from constipation or diarrhea. When affected with tuberculosis of the lungs, the animal has a persistent, harsh, dry cough and experiences some difficulty in breathing, especially after exercising. The lymphatic glands are considerably enlarged and the animal presents a general unthrifty appearance. A qualified veterinarian should test the animals with tuberculin to determine which are free from the disease. Reactors should be disposed of and tuberculosis eradicated from the herd with which the animals associated. The premises should immediately be cleaned and disinfected.

CONSTIPATION.

Constipation in hogs may be due, among other things, to lack of exercise and to the eating of too much dry feed or roughage. It can be corrected by making the animals take plenty of exercise

and by giving them feeds having a laxative effect, such as slops to which flaxseed meal is added. Increasing the quantity of green feed in the ration also helps to restore normal functioning. Young succulent alfalfa is especially good. In severe cases a dose of Glauber's or Epsom salts should be administered at the rate of 1 ounce to every 100 pounds of hog.

HEAT PROSTRATION.

Heat prostration results when the hogs have been driven or hauled a considerable distance during the heat of the day. Danger of prostration can be lessened by keeping the animals from becoming unduly excited. When prostrated by heat, the hog becomes very short winded, shows weakness of heart action and often considerable distress, and in many instances develops convulsions resulting in death. This condition may be lessened or prevented ordinarily by pouring water on the face and feet of the animal. The best method probably is by use of a sprinkler, keeping the water continuously running over the head and face and on the feet, and later on along the belly.

NODULAR SKIN DISEASE.

Nodular skin disease, called by the native Hawaiians puu puu, can not really be characterized as a disease. It is an affection of young pigs and is brought about principally by feeding an unbalanced ration, that is, one excessively rich in protein and therefore of a heating nature. Contributory causes include insanitary conditions, inadequate ventilation, and insufficient exercise. Animals affected with nodular skin disease should be given an occasional bath in some good disinfectant solution, such as creolin, or a 2 per cent solution of cresol compound, U. S. P., and the eruptions which have become covered with scab should be touched with tincture of iodine. A cooling diet which is laxative in effect is also recommended as a relief measure.

VERMIN AND INTESTINAL WORMS.

LICE.

Hogs infested with the common hog louse (*Hæmatopinus suis*) present an unthrifty appearance and suffer from irritation and itching. Lousy animals, filthy infected bedding, and insanitary quarters transmit the pest from one hog to another. Lice can be eradicated only by persistent and vigorous treatment. An efficacious treatment can be prepared as follows: To one-quarter pound of common laundry soap which has been dissolved by boiling in a little water, add 1 gallon of rain water. Remove the mixture to considerable distance from the fire to avoid explosion and while it is still hot pour into it 2 gallons of kerosene (coal oil) and then stir vigorously. The completed creamy emulsion should be diluted for use with 8 or 10 parts of warm rain water. A stiff brush or a swab of cotton should be used to cover every part of the animal's body with the solution.[6] Large numbers of affected animals can effectively be treated if they are immersed in a medicated liquid in a dipping vat.

[6] When hogs are treated with crude petroleum, they should be provided with plenty of shade and water to prevent skin scalding.

Small numbers need only a rubbing post. Occasional spraying with a solution composed of equal parts of kerosene and crude oil is effective for lice control. Another remedy is to float a thin film of oil over the hog wallows.

MANGE.

Scabies, or mange, in hogs is caused by small parasitic mites which live in the skin. It is characterized by wounds or lesions in the skin and by small cone-shaped swellings. The animal scratches or rubs the affected parts until the surface becomes raw. Scabs then form and the affected areas become leather-like and fall into wrinkles or folds. When the swine are mangy the yards and runways should be thoroughly disinfected and provided with rubbing posts which are covered with heavy cloth sacking saturated with crude oil. A rather expensive method of eradicating mange is by the use of a sulphur ointment.

WORMS.

The intestines of young pigs are frequently infested with worms. Pigs thus affected act in much the same way as they do when suffering from cholera, the only difference being that in the former case there is no fever and the ailment is confined to young animals only. Worm eggs and embryos are taken into the system in contaminated drinking water or food that is picked up in foul yards. All insanitary conditions should be removed, including the excreta of infected hogs, and the yards should be disinfected or else not used again by hogs for a year. The feeding of santonin and calomel (5 grains of each for every shote weighing from 50 to 75 pounds) with the ration is often effective in eradicating worms. In stubborn cases at the Haiku substation santonin and calomel were used or standard worm capsules were administered by means of a balling gun.

While the use of proprietary conditioners is not recommended, they occasionally give good results when added to a mixture of wood ashes, hydrated lime, finally ground phosphate rock, fine common salt, and finely ground copperas (iron sulphate). These ingredients should be thoroughly mixed and kept in a compartment of the self-feeder. An animal in good condition will be better able to resist attacks of worms than will one in poor condition. Worms impair the general health of swine, especially of young animals.

FEEDING EXPERIMENTS AND PRACTICES AT THE HAIKU SUBSTATION.

Two distinct series of feeding experiments and systems of swine management were conducted at the New Era homestead farm in conjunction with the Haiku substation during the period 1916–1920, inclusive.

The first series had for its object (1) the determination of the practicability of raising and fattening swine on pasturage ranging from one-tenth to one acre in maximum area; and (2) the determination of the palatability and relative feeding value of the various Hawaiian grown forage crops when they were pastured by, or fed as soiling crops to, swine, both with and without supplementary grains and other concentrates. From the data obtained it has been learned what amounts of pork may reasonably be produced per animal per acre

under good management. Further tests were made to compare the value of feeding concentrates from self-feeders with feeding by hand when swine were pastured, soiled, or kept in the dry lot, and also to ascertain the relative yields of the various crops when they were grown singly and in combination as intercropping. It was learned what systems of rotation gave the best results, the influence these systems had upon the fertility of the soil when the crops were pastured, and the relative costs of each.

The second series of feeding experiments was based on an intensive system of management, the swine being confined in small inclosures and fed mostly concentrated feeds with a minimum of pasturage and green soiling crops. A great deal of the feed was ground and cooked and the by-products fed included condemned carcasses, cassava starch refuse, cull beans, sugar cane molasses, and ground hay. The object of these series of experiments was to determine the difference between the two systems of management in economy of labor and feed, health of the animals, and average cost of swine production.

Only pure-bred Berkshires were used in these experiments. The herd included 10 brood sows and 2 herd boars ranging from yearlings to 5-year olds, together with about 40 young pigs not over 1 year old. The smallest number of hogs under test at any one time was 20 and the largest was 80. All animals were bred and reared on the farm excepting 5 of the 12 mature animals forming the breeding herd.

No contagious disease attacked the herd during the five years of its existence and only three mature animals were lost during the period, two as a result of faulty farrowing and one as a result of a dipping experiment. The average loss of small suckling pigs was slightly less than 20 per cent of the 500 pigs farrowed. Sows usually farrowed two litters a year, such farrowings totaling about 85 per cent of all the sows kept. The smallest litter farrowed was 5 pigs and the largest was 13. The highest number of pigs in a litter which were brought to maturity was 11, and the lowest was 3. No abortion occurred in the herd during the period of test, and the average number of pigs raised per sow per annum for the entire herd was a fraction over 10. In 1919, 7 sows brought to weaning age about 14 pigs each.

It is concluded from the experiment that with good management 10 pigs per sow per annum is a reasonably possible accomplishment in herds not exceeding 10 brood sows, which was the average number maintained at the Haiku substation and upon which these data are based. However, it is estimated that less than half of this number is the average production per sow in Hawaii as a rule. Such a high and profitable standard can be maintained only with good foundation stock which are carefully mated, well fed, and well cared for.

PLAN AND MANAGEMENT OF PASTURES AND RATIONS.

Figure 18 shows the general layout of the swine breeding and feeding plant at the Haiku substation at the beginning of the series of experiments in 1916.

The one-tenth-acre paddocks were found to be rather small at the end of the first year's trial for the support of sows having big litters. Two lots were therefore thrown together to form one-fifth-acre pad-

docks, and 10 such lots, comprising an area of 2 acres, were maintained throughout the rest of the experimental period. In addition

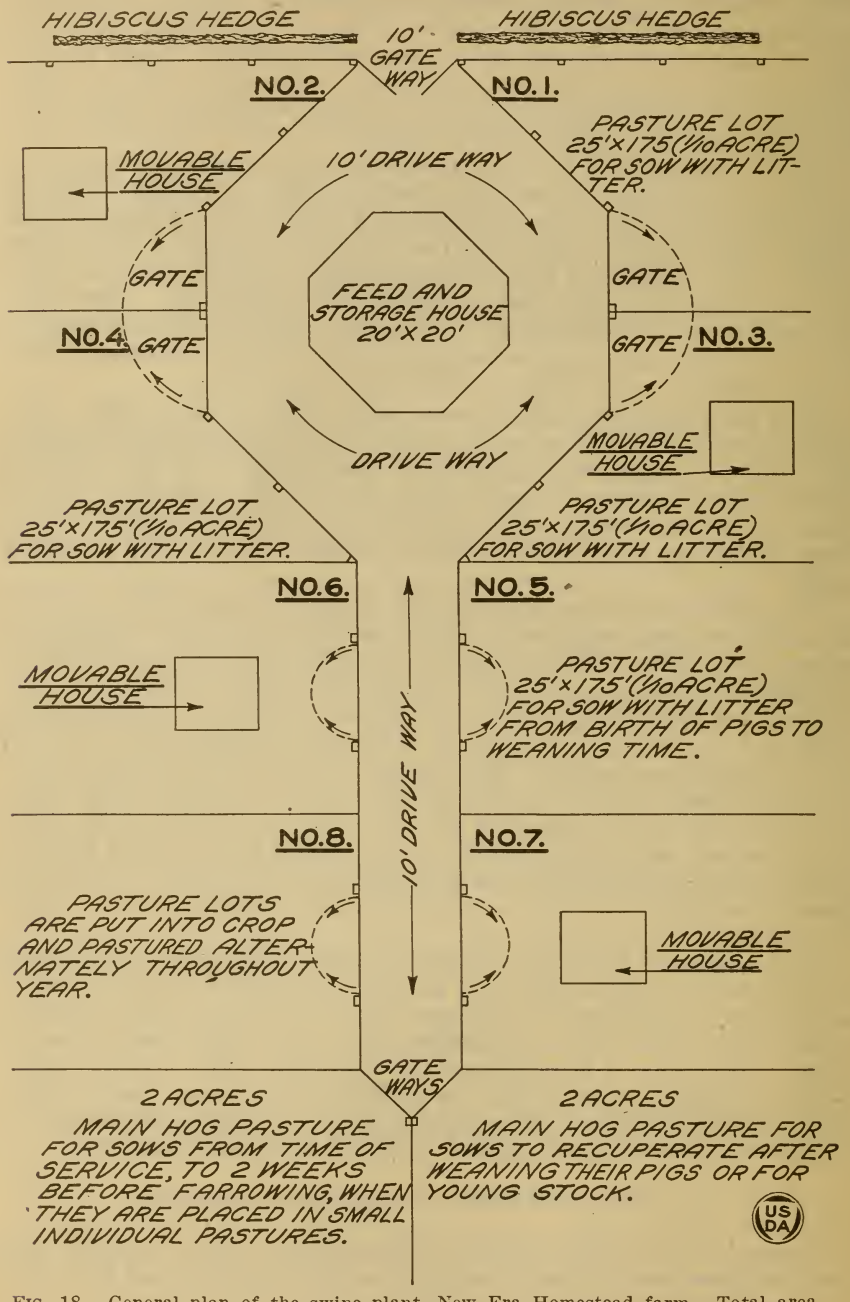
HIBISCUS HEDGE
10' GATE WAY
HIBISCUS HEDGE
NO.2.
NO.1.
PASTURE LOT 25'x175'(1/10 ACRE) FOR SOW WITH LITTER.
MOVABLE HOUSE
10' DRIVE WAY
GATE
FEED AND STORAGE HOUSE 20'X 20'
GATE
NO.4.
GATE
GATE
NO.3.
DRIVE WAY
MOVABLE HOUSE
PASTURE LOT 25'x175'(1/10 ACRE) FOR SOW WITH LITTER.
PASTURE LOT 25'x175'(1/10 ACRE) FOR SOW WITH LITTER.
NO.6.
NO.5.
MOVABLE HOUSE
PASTURE LOT 25'x175'(1/10 ACRE) FOR SOW WITH LITTER FROM BIRTH OF PIGS TO WEANING TIME.
10' DRIVE WAY
NO.8.
NO.7.
PASTURE LOTS ARE PUT INTO CROP AND PASTURED ALTERNATELY THROUGHOUT YEAR.
MOVABLE HOUSE
GATE WAYS
2 ACRES
MAIN HOG PASTURE FOR SOWS FROM TIME OF SERVICE, TO 2 WEEKS BEFORE FARROWING, WHEN THEY ARE PLACED IN SMALL INDIVIDUAL PASTURES.
2 ACRES
MAIN HOG PASTURE FOR SOWS TO RECUPERATE AFTER WEANING THEIR PIGS OR FOR YOUNG STOCK.
USDA

FIG. 18.—General plan of the swine plant, New Era Homestead farm. Total area, 5 acres; capacity, 50 hogs.

to the one-fifth-acre lots for dry sows, two paddocks, each 1½ acres in area, were provided for weaned and fattening pigs.

Each of the one-fifth-acre lots was planted in some desirable forage crop, and a definite system of crop rotation was planned and adhered to. Legumes, root crops, and nonleguminous crops were alternated except in instances where crops ratooned or sent up volunteers. In such instances the same crop was allowed to repeat itself.

Two or three weeks before farrowing time each sow was placed in one of the fresh lots in crop. Just before the animal was placed in her new quarters, a square rod of the crop was harvested and weighed to determine the approximate amount of green forage it contained. A portable hog cot having a built-in self-feeder was then placed in the lot and the sow was weighed. Excessively fat sows were not given grain or milled feed in addition to pasturage but they had access to mineral matter consisting of 10 parts of wood ashes, 5 parts of hydrated lime, 5 parts of finely ground phosphate rock, 3 parts of fine common salt, and 2 parts of finely ground copperas (iron sulphate). These ingredients after being thoroughly mixed were placed in a compartment of the self-feeder. Charcoal made an excellent supplement to this mixture. It may be added to form up to half of the total volume.

Sows which were in good flesh and about to farrow were placed in a fresh paddock containing good succulent crops and given a light grain-meal mixture amounting to about 1 pound per day for each 150 pounds of hog. When the animals were placed in good cowpea pasture that was heavily seeded, they were not given any concentrated feed. Brood sows which were in medium flesh were fed a medium grain-meal ration amounting to 2 and 2½ pounds per day for each 100 pounds of hog, and thin sows were given free access to the self-feeder to consume 3 to 4 pounds of grain meal daily per 100 pounds of hog in addition to the pasturage. Under the latter conditions sows gained over 1½ pounds per day and were able to maintain their increased weight for a reasonable period after farrowing. When the litters were 6 to 8 weeks old, these sows lost in flesh, but only in very few instances did they become excessively thin. At weaning time either the sow or her young were removed to another one-fifth acre paddock, or to one of the 1½-acre fields, depending upon the condition of the animals and of the pasture.

The feeding capacity of any field or paddock is dependent upon its yield and upon the skill with which it is fed to the animals. Although many of the forage crops will barely maintain an animal in fair condition, hogs at the Haiku substation gained from one-fourth to one-half pound daily when they were pastured or soiled on the best forage crops without the use of supplementary feeds. Swine that were allowed to run on good pasturage and fed in addition light, medium, or full rations of grain daily gained from 1 to 1¾ pounds. In most of the feeding trials animals pasturing on green feeds made better gains than did those on soilage. Pasturing was also more economical than soiling because it involved a smaller amount of labor. Rapid, if not very economical, gains were usually obtained through feeding full grain meal rations from a self-feeder, but the cheapest gains were often made on a light to medium supplementary grain ration. In the latter instance the hogs ate a large proportion of the relatively cheaper forage.

In the earlier experiments "free-choice" feeding methods were practiced; that is, the various kinds of feed were placed in separate compartments of the self-feeders so that the animals could select at will the kinds and quantities they desired. When they were pastured on alfalfa, cowpeas, peanuts, velvet beans, soy beans, and other leguminous crops, the hogs consumed comparatively little tankage or other animal protein feed, such as dried blood, dried milk, and the like. On the other hand, when they were pastured on nonleguminous crops, such as sweet potatoes, cassava, corn, and grasses, having a high carbohydrate content, over 10 per cent of the animal protein feeds was consumed. In all later feeding experiments mixtures were compounded in accordance with these findings.

Hogs pasturing on leguminous forage crops were fed from self-feeders mixtures of dry mashes composed of corn meal, cassava meal, wheat, or rice bran and shorts, with tankage or blood meal not exceeding 2.5 per cent and cane molasses up to and including 5 per cent. These rations had a nutritive ratio of 1:20. When the animals were pastured on such crops as sweet potatoes, cassava, Indian corn, Uba cane, and the like, the self-feeder rations were made up of alfalfa or pigeon pea meal, soy bean and peanut meal, oil-cake meal, mill run (bran and middlings), together with tankage, dried blood or dried skim milk to the amount of about 10 per cent. This mixture produced a nutritive ratio of approximately 1:3. The records of the Haiku substation show that the average consumption of these feeds per 100 pounds of hog was an average of $2\frac{1}{2}$ to $3\frac{1}{2}$ pounds daily, and that 300 to 400 pounds of such feeds produced 100 pounds of gain in swine when the animals were pastured in accordance with the above outlined cropping schemes. The average daily gains ranged from 0.75 to 1.5 pounds per animal, depending mainly upon the age and condition of the animals fed.

Enough data have been accumulated to show clearly that it pays to balance the feeding rations of swine, at least to the extent shown above, and that both forage crops and concentrated feeds must be carefully selected for palatability as well as for composition.

The table on page 31 shows the forage crops that have been grown most successfully at the Haiku substation both from the standpoint of yield and from the standpoint of value to the hogs.

Suggested cropping systems for swine in Hawaii.

Crops.	When to pasture.	When to harvest for soiling or curing.	Number of crops a year and average yields per acre.[1]	Carrying capacity, allowing 100 pounds to the hog, and length of time required to pasture an acre.	Total yearly gains per acre of hogs given grain feed from self-feeders to supplement pasture crops.
LEGUMES.					*Pounds.*
Alfalfa	At 8 to 12 inches high[2]	When half of crop is in bloom	6 to 8 crops; 15 to 30 tons	10 to 15 hogs; 10 to 20 days[3]	1,250
Cowpeas	When pods first ripen	When three-fourths pods are ripe	2 crops, each producing 1 ratoon; 20 to 30 tons.	15 to 20 hogs; 10 to 20 days[3]	1,400
Peanuts	When half the nuts are ripe	When seven-eighths pods are ripe	2 crops (sometimes producing a volunteer crop); 10 to 20 tons.	10 to 20 hogs; 10 to 20 days[3]	1,375
Velvet beans	When pods are maturing. (If pods are ripe and dry, plow under to soften and let hogs root.)	When all pods are ripe	2 crops; 20 to 30 tons	10 to 20 hogs; 10 to 20 days[3]	750
Soy beans	When half of pods are ripe	When all are ripe. (Seed usually shatters freely.)	2 crops; 8 to 15 tons	10 to 15 hogs; 10 to 20 days[3]	1,000
Pigeon peas	do	When all are ripe	2 crops; 10 to 15 tons	10 to 20 hogs; 10 to 20 days[3]	875
ROOTS AND TUBERS.					
Sweet potatoes	When most of tubers are mature	When most tubers are fully mature.	2 crops, each producing a volunteer crop; 10 to 40 tons.	10 to 20 hogs; 10 to 20 days[3]	1,500
Cassava	When roots are fully mature	When roots are fully mature	1 crop; 10 tons	10 to 20 hogs; 20 to 40 days	1,000
Edible canna	When bulbs are fully mature. (Cook before feeding.)	When bulbs are fully mature	1 crop; 10 tons	10 to 20 hogs; 20 to 40 days	1,000
Jerusalem artichoke	When tubers are fully mature	When tubers are fully mature	1 crop; 5 to 10 tons	5 to 10 hogs; 20 to 40 days	750
NONLEGUMINOUS AND NONROOT CROPS.					
Indian corn	When ears are mature	When ears are fully mature	2 crops; 4 to 10 tons (grain and stover).	10 to 20 hogs; 10 to 30 days	1,125
Grain sorghums	When grain is mature	When grain is fully mature	2 crops; 4 to 10 tons	10 to 20 hogs; 10 to 30 days[3]	900

[1] Two weights indicate average yields when grazed and soiled, respectively. The yields given represent yearly averages based on from 3 to 6 years. Cultural experiments during which from 1 to 3 crops were grown annually, depending upon the crop and the season. All these crops should be given a trial to determine which are best suited to the needs of the swine raiser.

[2] Ring hog noses and do not pasture too severely.

[3] For each crop.

Suggested cropping systems for swine in Hawaii—Continued.

Crops.	When to pasture.	When to harvest for soiling or curing.	Number of crops a year and average yields per acre.	Carrying capacity, allowing 100 pounds to the hog, and length of time required to pasture an acre.	Total yearly gains per acre of hogs given grain feed from self-feeders to supplement pasture crops.
NONLEGUMINOUS AND NONROOT CROPS—con.					*Pounds.*
Uba cane	When stems are tender and half-grown.	When stems are tender and three-fourths grown.	3 to 4 crops; 30 to 50 tons	10 to 20 hogs; 20 and 30 days [3]	750
Elephant grass	....do	....do	4 to 6 crops; 40 to 80 tons	10 to 20 hogs; 20 to 30 days [3]	750
Bermuda and Hilo grass pasturage.	At any and all seasons	When growth is fairly mature	Continuous	3 to 8 hogs; continuously	([4])
MISCELLANEOUS.					
Algaroba	Mature fallen pods are pastured	When mature pods fall	1 to 2 tons; 2 crops	5 to 10 hogs; 10 to 20 days	750
Cactus	When mature fruit can be knocked off.	When fruit is ripe	1 to 5 tons; 2 crops	2 to 5 hogs per crop	300
Pineapple	Mature cull fruits are left on plants for pasturing.	When mature cull fruits do not exceed, in feed, 2½ pounds per 100 pounds live weight per day.	3 to 5 tons; 1 crop	5 to 10 hogs; 15 to 30 days	([5])

[3] For each crop.
[4] Maintenance only.
[5] Maintenance only; sometimes detrimental.

LEGUMES.

Leguminous crops, including alfalfa, cowpeas, peanuts, velvet beans, soy beans, and pigeon peas are rich in protein and can be used to a large extent to replace imported grains and millstuffs.

Alfalfa is one of the best perennial forage crops for swine and can easily be grown, if conditions are favorable. It should be planted in January, February, March, and November, and 8 to 12 pounds of the seed should be sown per acre in drills 12 to 18 inches apart.

Cowpeas is one of the best all round annual forage crops for swine. The seed should be sown at the rate of 20 to 40 pounds per acre in rows 30 to 45 inches apart. The best time for planting is in February, May, October, and November. Cowpeas may produce one ratoon crop.

Peanuts, if fed in combination with corn, are especially fine for fattening hogs. Two bushels of nuts in pods, or about 20 pounds of shelled nuts, per acre should be planted in rows 30 to 45 inches apart. They may be planted in February, May, October, and November. Volunteer crops may be produced from seed that is left in the ground. If fed alone peanuts tend to produce a soft pork.

Velvet beans make an excellent hog forage if they are fed when the seeds begin to ripen and are supplemented with grain. About 50 pounds per acre should be sown in rows from 30 to 60 inches apart. They can be planted in February, May, October, and November and may produce one ratoon crop.

Soy beans seed heavily and make very nourishing forage for hogs. From 25 to 50 pounds of seed per acre should be sown in rows 30 to 45 inches apart. They can be planted in February, May, October, and November.

The pigeon pea crop, which is practically a new forage crop for swine in Hawaii, should, before feeding, be ground into fine meal for best results. From 10 to 20 pounds of seed per acre should be sown in rows 45 and 60 inches apart. The crop is a perennial and can be planted in February, May, October, and November.

ROOT AND TUBER CROPS.

Root and tuber crops are relatively low in protein content and high in carbohydrates. Among the best for swine feeding are sweet potatoes, cassava, edible canna, and Jerusalem artichokes.

The sweet potato is one of the cheapest crops to grow for swine. It should be supplemented with leguminous forage crops. The cuttings should be planted in lots of 10,000 per acre in rows 36 to 48 inches apart. The best time to plant is during February, May, October, and November. Tubers that are left in the ground are likely to produce volunteer crops.

Cassava is a rich feed in carbohydrate. It should be fed in combination with feeds that are rich in protein. From 3,500 to 4,500 cuttings may be planted per acre in rows 30 to 60 inches apart. The time of planting is February, May, October, and November. This crop does not ratoon.

Edible canna should be cooked before it is fed to swine. From 3,500 to 4,500 bulbs should be planted per acre in rows 30 to 60 inches apart. Edible canna may be planted in February, May, October, and November.

Jerusalem artichokes are greatly relished by swine. From 250 to 500 pounds per acre should be planted in rows 30 to 60 inches apart. The crop may be planted in February, May, October, and November.

NONLEGUMINOUS AND NONROOT CROPS.

Both the nonleguminous and the nonroot crops, including corn, grain sorghums, Uba cane, elephant grass, and Bermuda and Hilo grass pasturage, are rich in carbohydrate and inclined to be fibrous. Probably all with the exception of corn in mature grain may be classed as coarse roughage. They can be planted in February, April, October, and November.

Corn[7] is probably the most efficient of the fattening grains for swine. From 7 to 10 pounds per acre of the seed should be planted in rows 42 to 60 inches apart.

Grain sorghums, while inferior to corn, make an excellent grain feed for swine. From 5 to 8 pounds of the seed per acre should be sown in rows 42 to 60 inches apart.

Uba cane is an excellent nonleguminous forage for swine and is well liked by them. From 8,000 to 12,000 cuttings per acre should be planted in rows 42 to 60 inches apart.

Elephant grass is not as palatable for swine as is saccharine sorghum. From 8,000 to 12,000 cuttings per acre should be planted in rows 42 to 60 inches apart.

Bermuda and Hilo grass pasturage is excellent for swine to root in. It is a perennial and the sod or coarse clippings should be plowed under.

MISCELLANEOUS.

Among the miscellaneous hog feeds may be included algaroba pods, cactus fruits, and pineapple fruits.

Algaroba pods are excellent as a hog feed if not fed in abundance. For best results, they should be ground unless they are pastured. Select seedlings of heavy podding strains should be planted 20 by 20 feet with not more than 100 trees to the acre.

Cactus fruit, when pastured, is excellent as a hog feed.

Pineapple fruit, if very acid, should not be fed in excess to swine.

SYSTEMATIC ROTATION.

It has been conclusively demonstrated that grass crops should follow leguminous crops, and that all broadcasted and nonroot crops should follow cultivated and root crops. Under the cropping and feeding systems practiced at the Haiku substation, worn-out pineapple lands of low fertility, when hogged off, were brought up to a state of comparatively high fertility within three years. On the other hand, lands from which the crops had been removed and on which the hogs had not been allowed to run showed a decided tendency to soil depletion.

[7] Considerable corn on the ear has been fed to swine in Hawaii in the past. The small farmer in the Kula region of Maui invariably feeds corn to hogs when the price of corn drops below its feeding value, or when the price of pork reaches exceptionally high levels. High transportation charges on this crop have induced many of the farmers to feed it to swine, and this practice is likely to continue if hogs maintain their present high price.

METHODS OF SWINE MANAGEMENT PRACTICED BY LEADING RANCHERS.

The methods followed by some of the successful swine raisers of Hawaii are given in the hope that they may be of help to the beginner. The data presented were obtained either through interview or personal observation.

FIG. 19.—Kemoo farm. Pens for feeding garbage.

KEMOO FARM.

The Kemoo farm, located near Schofield Barracks, Oahu, has a swine herd numbering 1,460 animals, 250 of which are brood sows

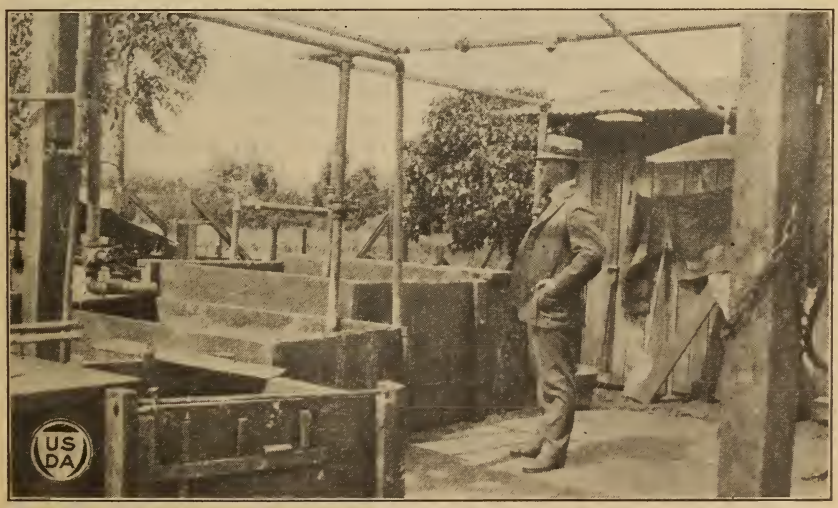

FIG. 20.—Kemoo farm. Concrete vats for steaming garbage.

of high grade and 10 are pure-bred Duroc-Jersey and Berkshire boars. (Figs. 19 and 20.) Each sow on this farm farrows, on the average, 3 litters in two years and raises 5 or 6 pigs per annum. Crossbreeding is giving fine results, a Duroc sow which was bred to a Berkshire boar, recently farrowing 16 pigs, only one of which was born dead, and 10 of which are being raised. Outstanding records show a Tamworth sow to have produced 45 pigs in 3 litters in a little over 15 months. One boar is maintained for every 25 sows.

Pigs are weaned at 8 to 10 weeks of age at an average weight of 25 pounds. As soon as they attain a weight of 60 pounds, they are placed in one-half acre dry paddocks in lots of 40 head. Here they are given some green feed, such as alfalfa, sorghums, and the like, together with all the garbage they can consume.

Eighty cans containing about 300 pounds of garbage each are daily hauled from the military posts to the Kemoo farm. All containers are thoroughly cleansed and sterilized by steam (100-pound pressure) and then dipped in lime wash. This process and the cost of hauling of course involve considerable expense.

In 1915 the Kemoo farm sold 365 garbage-fed hogs for $6,198, which averaged 11 cents a pound live weight. In 1918 the sales increased to 1,686 head which sold for $50,439, or about 22 cents a pound.

It has been estimated on the mainland that 1 ton a day of well-managed residence garbage will fatten 40 well-conditoned hogs and will develop an equal number of shotes or brood sows; while a ton of hotel or military post garbage will fatten 100 hogs and take care of 100 shotes beside. Garbage from hotels is very much more efficient as a feed than garbage from private homes. In well-established garbage feeding plants hogs weighing about 125 pounds each are selected and fed until they have attained a weight of about 250 pounds. This gain requires, under good management, about 100 days and represents an average daily gain of 1¼ pounds.

Some years ago the Kemoo farm conducted a number of feeding experiments to determine the feeding value of garbage for swine. Twenty-four pigs, grouped in lots of 3 to a pen, and weighing from 58 to 71 pounds at the beginning of the experiment, were given, for 50 days, a ration having garbage as the basic feed. Supplementary feeds, such as wheat middlings, alfalfa meal, rice bran, barley, corn, both separately and in combination, were added to the garbage in various proportions. The highest daily gain per pig was 0.7934 pound, which was obtained by feeding 4 pounds of rice bran and 1⅔ pounds of corn, respectively, per pig per day, in addition to all the garbage they would consume. The second highest daily gain per pig was 0.76 pound, which was obtained by feeding 2⅔ pounds of corn per pen of 3 pigs, in addition to all of the garbage the animals would consume. The lowest gain, 0.4534 pound, was made by pigs receiving 4 pounds of alfalfa meal in addition to all the garbage they would consume.

In a later experiment, 20 small pigs, in groups of 10 to a pen, were fed for 40 days. Those in lot 1 were fed garbage only and at the beginning of the experiment weighed a total of 298 pounds. At the close of the experiment they had made a total gain of 124 pounds. The pigs in lot 2 were fed 100 pounds of tankage in addition to the

garbage. Their total weight was 301 pounds at the beginning of the experiment and 462 pounds at the close, which was a gain of 37 pounds over the gain made by the pigs receiving no tankage. Only young pigs ranging from 20 to 30 pounds each were used in these experiments, and the gains on the whole were comparatively light. They plainly show, however, that certain kinds of supplements have an influence in weight when they are fed in combination with garbage, and likewise that the feeding of garbage is not necessarily the most economical method, especially for young pigs and brood sows, unless a supplementary feed is added to the ration. It pays well to supplement the garbage with a liberal amount of concentrated feed, such as dried blood or tankage, which has a high animal protein content. Large and economical gains can be made with such feeding unless, of course, the cost of the supplemental feed is abnormally high.

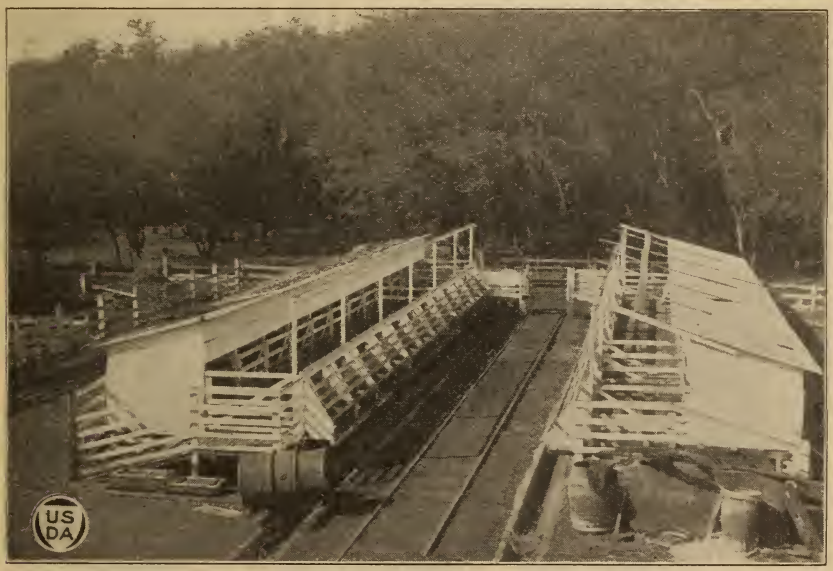

FIG. 21.—Molokai ranch piggery. Raised plank floors are cool and less expensive than concrete. Car track facilitates feeding.

MOLOKAI RANCH SWINE DEPARTMENT.

The following report was received from the swine department of the Molokai ranch, Kaunakakai, Molokai (Fig. 21):

Good algaroba pasture is more than a maintenance feed for swine, but it is not considered as good as corn, rice bran, or barley. On this ranch corn ranks first in food value, with rice bran second, barley third, and algaroba fourth. The hogs are not pastured on any planted crop, but are daily given one good feeding of green alfalfa. Rice bran is fed to fattening hogs only when corn and algaroba beans are not available. Corn is fed during probably four months of the year. When it is used, corn is given in regular amounts twice daily on cement floors, but rice bran or beans are fed from self-feeders. The hogs average daily gains of 1½ to 2 pounds each.

There are a few pure-bred swine at the ranch, but the greater number of animals are high grades. Practically everything is shipped to market from a pure-bred boar to hogs out of grade sows. The entire herd is so nearly pure

that it would be impossible to say whether pure breds or grades make the more economical gains.

Each sow averages one and one-half litters per annum, but only about four pigs per sow are actually raised and sold. This is a very low average, and is due to nodular skin disease, which carries off fully 40 per cent of the pigs per annum. The pigs are weaned when they are 2 to 3 months old, depending upon weather conditions and their health. All pigs have the run of pastures during some period of their lives, but are trough-fed when beans are out of season.

Cooked feed consists of sweet potatoes and potato tops, carcasses which are brought in from the ranch pasture, and rice bran, or barley. After being placed in a steaming vat for 4 hours the cooked stuff is fed mostly to sows with litters. No cooked feed is given to fattening sows.

PUAKO RANCH.

The swine department of Puako ranch, on the west coast of Hawaii, is managed with a minimum outlay of labor and equipment. Throughout the greater part of the year the hogs have the run of an extensive algaroba forest reaching to the sea, and they are fed from racks as much green alfalfa as they can consume. When algaroba pods are out of season the animals are fed beans from self-feeders.

KAMEHAMEHA MANUAL SCHOOL.

An early attempt was made at the Kamehameha schools to interest Hawaiian youth in swine raising. (Figs. 22 and 23.) These schools

FIG. 22.—Group of grade pigs, Kamehameha School, 1905. Only pure-bred Berkshires now at school.

now maintain fine pure-bred herds of swine and conduct valuable feeding experiments. In 1905 they conducted a feeding test with swine to demonstrate that algaroba beans have the same value as bran and barley as a fattening ration and can be used at half the cost of the imported concentrated feed. By the use of garden and kitchen waste in the ration, the cost of each pound of gain was further reduced.

The following report was submitted by the agricultural department of the Kamehameha schools:

Breeding.—

Breed gilts at 11 or 12 months for first litter.
Breed to drop second litter at 24 months.
Breed sows every 7 months thereafter for a litter.
Use young boar for light service at 9 months.

Housing.—

Place sows in 8 by 16 foot double farrowing houses having guardrail, and opening on leeward side; no draughts and very little bedding.
Pigs in out-of-door runs should have access to shelter during rainy season only.
Brood-sow pens should be provided with hog creeps.

FIG. 23.—Stock judging. Kamehameha School, 1905.

Yards.—

Should be furnished with artificial shade where trees are scanty.
Should be sprinkled during the middle of the day to lay dust and make pens cool.
Should be furnished with rubbing posts.

Feeding.—

Kitchen garbage should form basic ration and be supplemented with tankage.
Young pigs should be given equal parts of middlings, ground oats, and meal in the form of slop twice daily, beginning when the animals are about 1 month old and continuing until they are 5 months old. Not more than 15 young pigs should be fed in the same pen. After they are 5 months old the pigs should be fed kitchen garbage.
Boars should be daily fed wheat bran, ground oats, rolled barley, and wheat middlings in equal parts in the form of slop. Garbage is too fattening. A standard mineral mixture should be fed at the rate of 1 tablespoonful per hog once a day. Rolled barley in self-feeders should be used to supplement garbage in market pens. Self-feeders are not advisable for use of hogs that are kept for breeding.

Other features.—

Complete system of records are kept by the schools.
Boars are kept in individual pens.
Sows are bred in the latter part of the heat period.
Attention is given to sows at farrowing time.

Other features—Continued.
All pigs constantly receive attention.
Boars are castrated when they are 6 weeks old.
Cleanliness instead of vaccination is the precaution taken against disease.
All pigs are given a feeding of bran mash once a week.
Boars and overfat sows or difficult breeders are forced to exercise.
All pigs are daily inspected for sickness.
Experimental feeding is carried on.

Results of this management.—
The Kamehameha schools have a swine herd second to none in Hawaii.
Splendid individuals are developed for sale as breeding stock.
Market hogs weighing 200 pounds are produced in from 7 to 8 months at a profit of approximately $20 per hog.

OTHER RANCHES.

At the Haleakala and Harold Rice ranches on Maui extensive swine herds are pastured on Bermuda (Manienie) grass, with which the common prickly pear is freely mixed. Such pastures, especially during the prickly pear season, make cheap and excellent maintenance feeds.

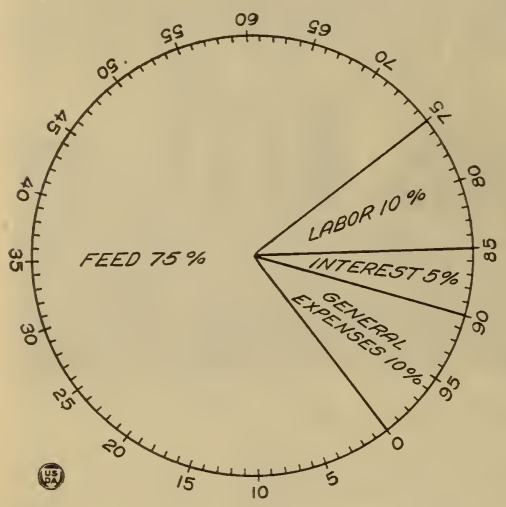

FIG. 24.—Approximate distribution of cost in swine production at the Haiku substation.

Since the prickly pear is so commonly found in Hawaii, the following data may be of interest in connection with its use in the swine ration:

In a series of tests conducted in California with slabs of Burbank spineless cactus, 8 pigs ranging from 35 to 80 pounds each were fed 20 to 30 pounds of the cactus daily for 22 days. At the end of the experiment the hogs showed a net gain of 118 pounds, or an average daily gain of two-thirds pound each.

When used to a limited extent at the Haiku substation, fresh shredded spineless cactus made a valuable green feed for swine.

SOME FACTORS GOVERNING SUCCESSFUL SWINE PRODUCTION.

Raising farm feeds economically and attending to details of management personally are the essential factors governing successful swine production. The outstanding item of expense is the feed and the second largest item is the labor employed. The greatest saving, and therefore the greatest profit, can be had only by exercising care in feeding and by the employment of efficient labor. (Fig. 24.)

Up-to-date business methods should be practiced regardless of whether the stock is to be sold on the market or kept for breeding purposes.

Breeding stock should be judiciously advertised and exhibited at fairs so that it will be brought to the attention of the public.

The breeder of pure stock should join the national and State associations of the breed in which he is interested.

Transfer and registration papers should be promptly attended to when registered stock are to be sold. All records should be kept accurately and in a presentable manner. A reputation once lost in the pure-bred stock business can not be regained.

System, business ability, and strict integrity are required for the development of a worth-while reputation as a reliable breeder.

The swine raiser should not attempt to breed for selling purposes until he has a well-established herd and a fairly complete equipment.

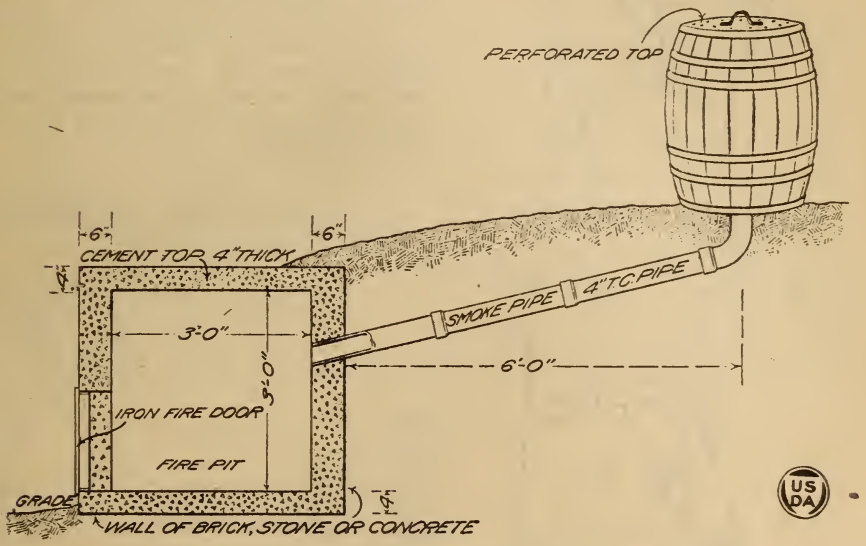

FIG. 25.—A cheap and effective farm smokehouse.

KILLING AND CURING[8]

Owing to the heavy demand for fresh pork at high prices, no cured products are as yet produced in Hawaii. However, the swine raiser who is favorably situated should butcher and cure the meat from some of the hogs on his farm. He will find it not only cheaper than purchasing meat, but also that he can, by selling the cured product, build up a lucrative business in a remarkably short time.

Only healthy animals should be selected for butchering. Disease from unhealthy animals may be transmitted to persons eating the meat.

At the Haiku substation excellent home-cured hams, bacon, sausage, and other pork products have been made by means of a home-made smoker. (Fig. 25.) None of the meat spoiled during the salting and curing process, even when the temperature reached 85° F. at the time of slaughter.

[8] For hints on equipment for slaughtering the animals and treatment of carcasses, see U. S. Dept. Agr., Farmers' Bulletins 913, Killing Hogs and Curing Pork, and 1186, Pork on the Farm: Killing, Curing, and Canning.

The animals were slaughtered either early in the morning or toward sundown, and the carcasses were at once split down the spine and cooled overnight in a specially louvered room.[9] The sides were cut into pieces of suitable size, and together with chucks exceeding 2 inches in thickness were injected the following morning with a solution[10] made by dissolving a pint of the highest-grade salt and a tablespoon of saltpeter in a quart of boiling water. After being cooled and strained this solution is injected clear to the bone. The meat is then placed in brine.

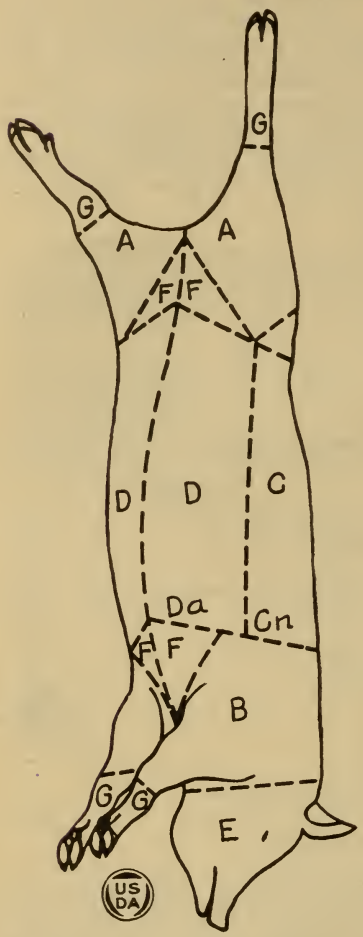

FIG. 26.—How to cut a carcass to advantage. A, hams; B, shoulders; C, fatback and loins; D, leaf fat and bacon; Ca and Da, ribs; D, bellies; E, jowl and head; F, trimmings; and G, feet.

The following data show into what products a good hog, weighing about 250 pounds, can be cut (Fig. 26), and also what percentage of live weight of the carcass each product represents.

Cuts and their percentage of live weight of the carcass of a hog weighing 250 pounds.

Cuts.	Proportion of whole animal.
	Per cent.
Hams	12.50
Shoulders	10.50
Sides	21.45
Loins	9.75
Prime steam lard	12.50
Tenderloins, spareribs, tails, snouts, etc.	6.50
Leaf fat	2.80
Casings, heart, liver, cheek meat, etc.	12.00
Moisture and offal	12.00

Carcasses weighing from 120 to 140 pounds (fresh pork) bring the highest market prices in Honolulu. Hogs weighing over 200 pounds are less in demand, and heavy hogs, such as find ready sale in the States, are difficult to dispose of on the local markets.

TERRITORIAL REGULATIONS GOVERNING THE IMPORTATION OF SWINE.

SECTION 1. All pure-bred swine intended for shipment to the Territory of Hawaii for breeding purposes must be accompanied by a certificate of health issued or approved by an officer of the United States Bureau of Animal Industry or by the State veterinarian, to the effect that the animals have passed a careful veterinary inspection and are free from any indication of disease, and that

[9] A room with walls made of well spaced boards which are sloped to shed rain and fashioned somewhat like window shutters to admit light and air.

[10] A patented meat salter was used for this purpose. It is a rather large instrument resembling a hypodermic syringe and is used with a specially constructed needle.

neither hog cholera nor swine plague has existed within a radius of 5 miles of the premises on which they have been kept for a period of six months immediately preceding the date of shipment.

SEC. 2. The owner or importer must present an affidavit to the effect that the said certificate refers to the swine in question, that the same have been shipped from the premises mentioned in said certificate in clean and disinfected cars, without unloading, and that they have not been submitted to the serum simultaneous or double treatment for hog cholera within 30 days prior to shipment.

SEC. 3. All pure-bred swine intended for breeding purposes arriving in the Territory without such certificate and affidavit shall be subject to a quarantine of 2 weeks at the expense of the owner or importer.

SEC. 4. All butcher hogs intended for shipment to the Territory of Hawaii for the purpose of fattening for the market must be accompanied by the certificates and affidavits as in sections 1 and 2 described.

SEC. 5. Such swine arriving without the required certificates and affidavits shall not be allowed to land in the Territory.

SEC. 6. All butcher hogs intended for shipment to the Territory of Hawaii for the purpose of immediate slaughter must be accompanied by the certificates and affidavits as in sections 1 and 2 described and shall be unloaded into cars, drays, or trucks and transported direct to the place of slaughter and shall not be disposed of in any other way than by slaughter.

SEC. 7. All such cars, drays, or trucks shall be thoroughly cleaned and disinfected under the supervision of the Territorial veterinarian before being allowed to return for reloading or to be used for any other purpose, such cleaning and disinfection to be at the expense of the owner or importer.

SEC. 8. The Territorial veterinarian may permit the landing and slaughter of such swine when unaccompanied by the certificates and affidavits required by this regulation providing that upon arrival and inspection they are found in good health and are apparently free from all swine disease and are slaughtered within 2 weeks after arrival.

SEC. 9. All swine of whatsoever character arriving in the Territory exhibiting symptoms of hog cholera, swine plague, or any other disease contagious to swine shall not be allowed to land.

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